CLAIMS:

1. A capillary mixer for mixing a first reactant solution and a second reactant solution to form a mixed solution prior to delivering the mixed solution to an ion source of an ionization mass spectrometer, which mixer comprises:

a pair of concentric capillaries consisting of:

an outer capillary which is connected at a distal end thereof to an inlet of the ion source and is to be connected at or near a proximal end thereof to a source of the second reactant solution; and

an inner capillary within the outer capillary, thereby forming an annular intercapillary space between the outer and inner capillary, wherein:

the inner capillary is to be connected at a proximal end thereof to a source of the first reactant solution and has an opening at or near a distal end thereof, is slidably sealed to the outer capillary at or near the proximal end of the outer capillary and is movable back and forth within the outer capillary,

whereby in use, the first reactant solution is delivered from the source thereof through the inner capillary in a direction from the proximal end toward the distal end and the second solution is delivered from the source thereof through the intercapillary space in a direction from the proximal end to the distal end; and

the first and second reactant solutions so delivered get mixed to form the mixed solution in a mixing

region within the intercapillary space into which the first reactant solution is expelled through the opening.

2. The capillary mixer according to claim 1, which further comprises:

a mixing section between the distal end of the outer capillary and the inlet of the ion source, for adding a further liquid to the mixed solution immediately prior to being delivered to the ion source.

3. The capillary mixer according to claim 1, wherein the outer capillary is integrally formed with the inlet of the ion source.

4. The capillary mixer according to claim 1, wherein the inner capillary is plugged at the distal end thereof and one or more of the openings are formed in a wall of the inner capillary so that the first reactant solution is expelled laterally with respect to an axis of the capillaries into the mixing region.

5. An ionization mass spectrometer for determining a reaction rate of first and second reactants in a solution, which comprises:

an ion source;

a mass spectrometer downstream of the ion source; and

a capillary mixer comprising a pair of concentric capillaries consisting of:

an outer capillary connected to an inlet of the ion source, and

an inner capillary within the outer capillary, thereby forming an annular intercapillary space between the outer and inner capillaries, wherein:

the inner capillary has an opening at or near a distal end thereof close to the ion source, is movable back and forth within the outer capillary and is slidably sealed to the outer capillary at or near a proximal end of the outer capillary,

whereby in use, the first reactant solution is delivered from a source thereof through the inner capillary in a direction from the proximal end toward the distal end, and the second reactant solution is delivered from a source thereof through the intercapillary space in a direction from the proximal end toward the distal end;

the first and second reactants so delivered get mixed to form a mixed reactant solution in a mixing region within the intercapillary space into which the first reactant solution is expelled through the opening; and

the mixed reactant solution is delivered from the mixing region to the ion source.

6. The ionization mass spectrometer according to claim 5, wherein the ion source is an electrospray ion source; and the ionization mass spectrometer is an electrospray ionization mass spectrometer.

7. The ionization mass spectrometer according to claim 5, wherein the ion source is an atmospheric pressure ionization source; and the ionization mass spectrometer is an atmospheric pressure ionization mass spectrometer.

8. The ionization mass spectrometer according to claim 5, in which the capillary mixer further comprises:

a mixing section between the distal end of the outer capillary and the inlet of the ion source, for adding a further liquid to the mixed solution immediately prior to delivering the mixed solution to the ion source.

9. The ionization mass spectrometer according to claim 5, wherein the outer capillary is integrally formed with the inlet of the ion source.

10. The ionization mass spectrometer according to claim 5, wherein the inner capillary is plugged at the distal end thereof and one or more of the openings are formed in a wall of the inner capillary so that the first reactant solution is expelled laterally with respect to an axis of the capillaries into the mixing region.

11. The ionization mass spectrometer according to claim 5, wherein the mass spectrometer downstream of the electrospray ionization unit is a triple quadrupole mass spectrometer.

12. A method of analyzing a solution phase reaction of first and second reactants using an ionization mass spectrometer comprising:

an ion source;

a mass spectrometer downstream of the ion source; and

a capillary mixer comprising a pair of concentric capillaries consisting of:

an outer capillary connected to an inlet of the ion source, and

an inner capillary within the outer capillary, thereby forming an annular intercapillary space between the outer and inner capillaries, wherein:

the inner capillary has an opening at or near a distal end thereof close to the ion source, is movable back and forth within the outer capillary and is slidably sealed to the outer capillary at or near a proximal end of the outer capillary,

which method comprises the steps of:

delivering the first reaction solution from a source thereof through the inner capillary in a direction from the proximal end toward the distal end and delivering the second reactant solution from a source thereof through the intercapillary space in a direction from the proximal end toward the distal end,

expelling the first reactant solution through the opening into a mixing region within the intercapillary space to mix the first and second reactant solutions, thereby forming a mixed reactant solution and initiating the solution phase reaction, and

delivering the mixed reaction solution from the mixing region to the ion source, to form ions of at least one product or intermediate product or both of the reaction, the ions being detected by the mass spectrometer.

13. The method according to claim 12, wherein the steps are conducted in a kinetic mode by continuously

pulling back the inner capillary to provide intensity-time profiles for the product or intermediate product.

14. The method according to claim 13, wherein, separately from the kinetic mode, the steps are conducted in a spectral mode by fixing the inner capillary at a point relative to the outer capillary, to provide entire mass spectra for a selected reaction time.

15. The method according to claim 12, wherein the solution reaction is an enzyme catalysis; and one of the first and second reactants is an enzyme and the other is a substrate for the enzyme.

16. The method according to claim 15, wherein the enzyme is a serine protease.

17. The method according to claim 15, wherein the substrate is non-chromophoric.

18. The method according to claim 15, in which a pre-steady state of the enzyme catalysis is analyzed.

19. The method according to claim 12, wherein the ion source is an electrospray ion source; and the ionization mass spectrometer is an electrospray ionization mass spectrometer.

20. The method according to claim 19, which further comprises:

adding an electrospray ionization-friendly make-up solvent to the mixed solution through a mixing section between the distal end of the outer capillary and the inlet of the electrospray ion source, immediately prior to

delivering the mixed solution to the electrospray ion source.

21. The method according to claim 20, wherein the electrospray ionization-friendly make-up solvent acts also to quench the solution reaction.

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